BEDSIDE MEDICINE FOR BEDSIDE DOCTORS

An Open Forum for brief discussions of the workaday problems of the bedside doctor. Suggestions of subjects for discussions invited.

ASSOCIATED VALUES OF CLINICAL AND RADIOGRAPHIC FINDINGS IN THE DIAGNOSIS OF CHRONIC PULMONARY TUBERCULOSIS

PATHOLOGY AND PROGNOSIS

L. H. GARLAND, M. D. (450 Sutter Street, San Francisco).—Chronic pulmonary tuberculosis is characterized by the multiplicity of its pathologic changes. These include varying numbers of conglomerate tubercles, gross nodules, areas of caseous pneumonia, fibrosis, calcification, cavities, local atelectases and emphysemata, pleural thickening, adhesions, and effusion. The pathologic appearance, therefore, is variable. Despite all this variability, however, there are certain features common to the majority of cases: the lesions usually lie in the upper lobes, they tend to progress downward, and frequently they are bilateral. Lobular infiltrations in a similar location of other than tuberculous origin can, of course, simulate tuberculosis.

It is generally recognized that stereoscopic roentgenograms constitute the most precise and accurate means of determining the extent of pathologic involvement. While it is important that the roentgen examination be technically as perfect as possible, and that an adequate number of views be made, as well as a thorough fluoroscopic examination, it is considerably more important that an adequate and intelligent interpretation be made. The pathology of chronic pulmonary tuberculosis can be detected with extraordinary completeness if the films are studied by a competent radiologist, that is, by one who is adequately trained and who has an opportunity each year to attend a sufficient number of autopsies to keep fresh in his mind the dangers of interpreting too much or too little from the roentgen shadows.

The presence of cavities is of such significance in the treatment of the disease that their early diagnosis is of prime importance, and the early diagnosis of cavity can only be made by the roentgenogram. When a cavity can be diagnosed by physical signs, the disease is usually in a far-advanced stage. In addition to satisfactory roentgenograms, the fluoroscopic "cough test," to detect thin-walled cavities not otherwise demonstrable, should be employed. Limitation of space prevents a discussion of classification here; however, we note that at Trudeau Sanatorium and other centers the roentgen signs, instead of the older physical signs, are used as its basis.

The radiologist is often asked to give an opinion as to the degree of activity present; the most accurate method of doing this is by the study of serial stereoscopic roentgenograms. In this connection it should be emphasized that the roentgenogram should never be allowed to stand alone, but should always be correlated with all of the clinical findings. In general, the relative value of clinical and radiographic findings can be well illustrated by reproducing the accompanying table (Table 1) taken from Sampson and Brown's article.*

TABLE 1.—*Correlation of Physical Signs (P. S.) with X-Ray Findings (X. R.) in 1004 Cases of Pulmonary Tuberculosis*

P. S. Equal to X. R.	P. S. More than X. R.	P. S. Less than X. R.	P. S. Nil X. R. Pos.	P. S. Pos. X. R. Nil	Mixed	392 Cases with Cavity P. S. in 58 15%
211	19	361	396	0	17	
21%	2%	36%	39%	0	2%	

As far as prognosis is concerned, serial roentgenograms again constitute the basis upon which the duration and severity of the disease may best be gauged. The grave implications of a cavity, and the importance of determining the condition of the surrounding lung tissue, indicate the value of roentgen examination. If one were compelled to utilize but a single roentgen examination in establishing the prognosis in a given case, the clinical findings and history would possibly far outweigh the roentgen findings; however, in view of existing facilities in most localities, to hazard prognosis from a single roentgen examination would appear both unwise and unnecessary. Serial roentgen examination, using intervals of from one to six months, depending on the severity of the case, constitutes the most accurate means of prognosis.

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DIAGNOSIS

HENRY SNURE, M. D. (1501 South Figueroa Street, Los Angeles).—The greatest value of the roentgenologic examination is in the early cases of pulmonary tuberculosis, when the clinical signs are absent or indefinite, and in the assistance it gives in checking up various surgical procedures; yet its value in the diagnosis of chronic pulmonary tuberculosis should not be underestimated. It is true that many chronic cases of pulmonary tuberculosis, with little or no clinical signs referable to the chest, are first discovered by the roentgeno-

* "Correlation of Clinical and Roentgenologic Observations in Pulmonary Tuberculosis," Radiology, 22:1, 1934.

logic examination. These patients come in with gastric or other symptoms not suggestive of pulmonary tuberculosis; the referring physician may feel that he has been remiss in his physical examination in not discovering the tuberculous infection, yet a careful repeat physical examination, with the knowledge of the exact location and size of the tuberculous area as disclosed by the roentgenologic examination, will yield negative results. Heise has pointed out that cavities as large as five to six centimeters in diameter may not give any physical signs. The clinical signs, such as increased weight, cessation of fever, etc., may indicate improvement while the roentgenogram shows a definite anatomical extension of the disease.

It is also true that in cases of long duration of active infection which reveals itself as the stringy type of shadow on the roentgen film, the so-called chronic proliferative type, the increased temperature or other clinical signs may continue for months, or even years, without any definite anatomical change demonstrated on the film. It is important, therefore, that the roentgenologist have a complete history of the case in question—whether examining his own films or those made elsewhere—that he may evaluate the limitations or importance of his particular method of examination as applied to the particular case under discussion.

The investigation of large groups of individuals in industry affords an opportunity to study the associated values of clinical and roentgenologic findings in the diagnosis of chronic pulmonary tuberculosis.

In an examination of two thousand food handlers in New York City, Martin, Pessar, and Goldberg found two per cent of active pulmonary tuberculosis in apparently healthy individuals. They are outspoken concerning the comparative value of the physical examination and the x-ray, stating that "when the question of tuberculosis is involved no physical examination of the chest is of any value without the x-ray." Possibly the above is somewhat overenthusiastic. It must be remembered that it is the combined physical and roentgenologic examination that is of the most value, and that all methods have their limitations. During the past year I have seen three cases of chronic infection of the lungs by Friedlander's bacillus, in which the physical examination and roentgen film favored tuberculosis, yet the clinical laboratory examination supplied the correct answer. The diagnosis of actinomycosis, moniliasis, or other fungi may depend entirely on the clinical laboratory examination. What may appear to be a typical case of silicosis by roentgen-ray and physical examination may be proved to be also tuberculous by the presence of bacilli of tuberculosis in the sputum. Space does not permit discussion of atypical roentgen-ray findings in bronchiectasis, resolving pneumonia, metastasis, bronchiolitis, etc., that may resemble tuberculosis.

In another large group of employees and applicants that were carefully examined both by roentgen-ray and physical examination with the express purpose of determining the value of the two methods of examination, a larger percentage of tuberculous patients were found by means of the roentgen ray. These were employees of the Metropolitan Life Insurance Company, and the results of seven years' study of the various examinations in 17,000 individual cases was reported by Fellows in the February, 1935, number of the *American Journal of Public Health.* This study was begun because it was noticed that a certain number of employees developed definite tuberculosis only a few months after a careful physical examination that was negative for evidence of tuberculosis. The fluoroscope was used instead of films because it was more economical, although stereoscopic films would give a somewhat larger number of positive findings. Fellows sums up the report as follows: "After seven years' experience with our present routine of chest examination, we believe that we have made real progress in handling our pulmonary tuberculosis problem. Realizing that a physical examination, no matter how painstakingly done, does not reveal abnormal signs in a large number of tuberculous cases, we have met this shortcoming by adding a routine fluoroscopic examination and roentgenographic examination of cases selected by this method for further study. From the administrative standpoint, this method is rapid and economical, as, checked by x-ray examination, it is accurate."

By means of the roentgen ray the majority of their cases were detected before the individual became "ill," and before physical signs appeared.

For those especially interested in the correlation of clinical and roentgenologic observations in pulmonary tuberculosis, I would recommend a careful reading of an excellent article on this subject in the January, 1934, number of *Radiology* by Homer L. Sampson of the Trudeau Sanatorium and Dr. Lawrason Brown of Saranac Lake. The following excerpts are practically verbatim statements. They believe that the roentgenogram alone yields sufficient accurate data to classify tuberculosis and point out that recent advances in the study of the etiology, diagnosis, prognosis, prophylaxis, and treatment of pulmonary tuberculosis are rather closely associated with the technical improvement in the roentgenogram. Collapse therapy, and especially thoracoplasty have developed largely since the perfection of the roentgenologic examination. They also state that serial roentgenograms are probably the most accurate means of determining activity. Note carefully, also, that they believe the roentgenograms should be used to perfect, *not to replace,* the usual methods of physical diagnosis in pulmonary disease. In a study of 280 patients with minimal pulmonary tuberculosis, it was shown that 277 had definite roentgenologic evidence and only seventy-six presented definite evidence of physical signs.

In still another attempt to compare relative values of physical signs and roentgenologic findings, when 1,004 consecutive patients were studied, 392 of these patients had definite roentgenologic signs of cavity, while only 58 (15 per cent) had physical signs suggestive of cavity. In 211 cases the extent of the disease was equally shown by both methods. In nineteen cases the physical examination suggested greater extent than the

roentgenogram. In 361 cases the roentgen ray indicated greater extent than was inferred from physical signs. In 396 the roentgenogram showed definite evidence of pulmonary tuberculosis, while the physical signs were practically normal.

In another series of 1,367 patients diagnosed as having tuberculosis, 68.5 per cent had definite râles and 99 per cent definite roentgenologic findings.

Another study of 503 patients with indefinite or negative physical signs and positive roentgen-ray findings, 84 per cent later presented clear-cut clinical evidence of the disease. In still another study of 2,600 consecutive cases, with 298 negative roentgenograms, only two with negative roentgenograms later developed tuberculosis.

The above excerpts from Doctor Brown's paper clearly indicate the superiority of the roentgenogram as compared with the physical examination.

Recently some authors have stated that the leukocyte reaction is superior to both roentgen-ray and physical examination; at any rate the roentgenogram is placed ahead of the physical examination. I believe that the majority will agree with Heise, who, in speaking of the adult type of tuberculosis, states: "As with childhood disease, the x-ray gives a great deal more definite idea as to the presence, the extent and character of the disease than can be elicited from physical signs." He also reminds us that while hemoptysis may suggest tuberculosis, yet the roentgen-ray examination can disclose bronchiectasis, heart lesions and malignant growths of the bronchii, lungs and pleura as the cause. I think the majority will also agree with Merrill when he states: "Without going into technical details, the x-ray study of the chest is a complex matter requiring as much knowledge as possible of the different manifestations of lung pathology, as well as normal anatomy and physiology, and experience in the interpretation of the characteristics of the normal and pathological chest negative."

While in large groups of school children and employees the roentgen-ray examination may be used as a routine procedure, the cases in private practice will continue to be referred on the basis of history and physical examination. Although the roentgen examination appears to be superior to the physical examination alone, the proper study of the individual case demands the use of both methods, plus any help that the clinical laboratory may give us.

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CORRELATION OF ROENTGEN AND CLINICAL FINDINGS

JOHN D. LAWSON, M.D. (1306 California State Life Building, Sacramento). — The diagnosis, prognosis and treatment of pulmonary tuberculosis have received great stimulus since the advent of roentgen investigations of the thoracic cage. This is particularly true of the past decade, during which period much improvement has been made in physical equipment necessary in the production of diagnostic roentgenograms.

It is true that no aggregate of signs, symptoms, or examinations, other than the actual demonstration of tubercle bacilli in the sputum, is finally diagnostic of parenchymal pulmonary tuberculosis. However, in competent hands, associated clinical and roentgenologic findings have become so accurate and valuable that the percentage of diagnostic error is so low as to be negligible.

The common tendency of physicians to refer all chest cases to the radiologist for examination, and then to accept his diagnosis, without a careful history and examination of the patient, is to be heartily condemned. It is true that the radiologist will make a correct and proper diagnosis in a high percentage of the patients; but this duty and privilege should rest absolutely with the clinician. He should arrive at his diagnosis only after a careful and painstaking examination and association of his findings with those of the radiologist and other consultants.

Authoritative statistics indicate that roentgen diagnosis in incipient disease is more accurate and will have a higher percentage of correct positive findings than will the physical examination. However, there is a certain small group of patients who on x-ray examination do not evidence any positive pathologic change, but do present on careful physical examination definite evidence of a Koch's infection.

It is in the early and borderline cases, and where the question of differential diagnosis enters, that the radiographic findings are of most importance and value. Certainly, the diagnosis of a far-advanced tuberculosis of the lungs, with cavitation and caseation, is not a clinical question requiring the confirmation of the roentgenologist. True, roentgen findings may play an important part in prognosis and treatment, but so far as diagnosis is concerned the history and physical examination are sufficient in themselves.

If it is agreed that the foregoing paragraph is true, then it must follow that the most careful technique, together with all of the finer modifications of radiographic procedures, must be utilized to produce films of the highest quality. Not only must this dictum be followed, but interpretation should not be attempted by a novice, nor by one who has not had proper training in radiographic diagnosis. The diagnosis of borderline cases requires a detailed knowledge of anatomy, physiology, pathology and, most important of all, the roentgen manifestations of variations from the normal.

The use of sensitized paper, inadequate equipment and interpretation by one not adequately trained in roentgenology is worse than no investigation at all. Those patients who have moderately advanced or far-advanced lesions will probably be correctly diagnosed. Those same patients will also have a proper clinical diagnosis. But the few patients with early lesions, with questionable physical findings, the ones in whom a good clinical result can be assured, will probably be missed.

These incipient and borderline diagnoses are difficult in the hands of experienced and qualified radiologists when they have at their disposal all of the facilities for the best work, and exercise these facilities to the utmost. How foolhardy and wrong it is for unqualified individuals, whether

they be lay or professional, to attempt this field at the expense of the patient's health and possibly at the expense of his life!

It is highly desirable that the clinician should consult personally with the roentgenologist. Both are physicians, and in their conference the individual findings should be gone over in detail, discussing the various points of importance brought out by each examination.

Certain findings, such as fibrosis, caseation, cavitation, and adenopathic changes, will have considerable bearing on the prognosis and treatment of the patient. The location of the lesion, as demonstrated on the plate, is of considerable importance, and yet the radiologic findings are not, of themselves, sufficient to stand alone. The reaction of the patient to the infection, which may be seen to a degree in the x-ray examination, is of course observed in detail in the clinical study. The general health and other modifying factors can only be evaluated from the clinical findings.

The differential diagnosis of some lesions can be accomplished only through correlation of findings. An excellent example of this statement was observed recently in a patient complaining of cough, profuse sputum, afternoon febrile reaction, and slight weight loss. These symptoms were of about one month's duration.

Physical examination revealed a slightly dull area, about the size of a dollar, in the right top. In this same area were heard many fine crepitant râles and some coarse rhonchi. Radiographic examination revealed an area of consolidation, about three centimeters in diameter, in the right upper lobe and a slight increase in density in the right hilus region, due to adenopathy. The remaining parenchymal areas were clear.

On physical examination an area of tumefaction was observed in the right submaxillary area. On questioning, the patient stated that this lump had appeared about two months before, but that it had not caused him any difficulty and that he had not paid any attention to it. The tumor was hard and smooth; there was some slight erythema over the lesion, certainly not a characteristic tuberculous gland. Biopsy was done, and the sulphur granules and ray bodies of actinomycosis were identified. On the basis of these findings the lesion in the chest was diagnosed and treated as an actinomycotic metastasis, and the patient experienced a slow but absolute recovery.

On the basis of roentgen findings alone, this man would have been diagnosed as having pulmonary tuberculosis and treated as such. The correct diagnosis would not have been made until a much later date, by which time the disease might have progressed to an incurable stage.

This is not an isolated instance of the necessary association of the clinician and the roentgenologist in the diagnosis of tuberculosis. Similar occurrences are observed almost daily.

The prognosis and treatment of tuberculosis find the roentgenologist furnishing invaluable aid to the clinician. Processes of extension or regression, too small in degree to be accurately estimated by clinical procedures, are evidenced quite clearly to the trained radiologist, and can be of great assistance in determining the mode as well as the efficacy of the therapy.

If only one conviction can be gleaned from this short discussion, I trust that it will be that consultation and correlation of findings between the clinician and radiologist are of greatest importance. A primary premise is, however, that the radiologist is properly qualified, and has used all of the finest points of technique and diagnostic procedures available in formulating his opinion.

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THE RADIOGRAPHIC EXAMINATION IN CLINICAL PRACTICE

CARL R. HOWSON, M. D. (307 West Eighth Street, Los Angeles).—The radiographic examination of the chest is an integral part of the physical examination; it is a form of internal inspection. True, it falls far short of yielding the exact knowledge which an actual inspection of the tissues discloses, but it nevertheless does give information which is frequently not obtainable in any other way.

Many factors operate to prevent the transmission of changes in the breath sounds which would convey to the examiner definite knowledge of pathologic changes in the pulmonary tissues. Those most commonly met with are thickened pleura, the presence of a thin layer of air-bearing tissue superficial to the diseased area, obstruction to the free flow of air in and out of a cavity, location of infiltration or cavitation at a point inaccessible to the stethoscope, etc. Great differences in the ability of individuals to elicit and detect the physical signs originating in the chest are apparent, even among the expert. For these and other reasons set forth below, no examination of the chest is complete unless it includes a postero-anterior roentgenogram, preferably stereoscopic, and at times one or more additional views taken at different angles or in different positions.

Cases of true *acute tuberculosis* (miliary, pneumonic, or bronchopneumonic) are not met with very frequently in general practice, and when seen they not uncommonly offer difficulties in diagnosis. This is especially true of the early stages of acute miliary tuberculosis, where the radiographer can usually settle any question promptly and definitely.

As a rule, the *diagnosis* of chronic proliferative (fibroid) tuberculosis can be made by a carefully taken history and a physical examination, particularly when the findings are confirmed by the presence of acid-fast organisms in the sputum. Occasionally, small apical lesions will be missed.

The exudative type of lesion commonly has an acute onset. A process of fairly large extent can usually be detected without difficulty, but small lesions have a decided tendency to locate in the infraclavicular region, often coming to the surface under the shoulder or scapula, where they are almost inaccessible to the stethoscope and may very easily be overlooked if a film is not made. With the subsidence of the acute stage, we frequently have the development of a mixed type of lesion, to which the term "fibrocaseous" is applicable. In both these types there is a marked tendency to cavity formation.

The difficulty of diagnosing cavitation with certainty on the basis of the physical findings alone has long been recognized, but it is only since the systematic use of the x-ray became general that we have realized how great the difficulty really is, and how many cavities have been overlooked. It requires only a layer of thickened pleura, or one centimeter of air-bearing lung tissue superimposed between the cavity and the chest wall to convert it into a "silent" cavity, giving no physical findings whatever that would suggest its presence—unless one might infer it from evidence of fibroid retraction in its vicinity. A few years ago the phthisiologists felt that they were being generous when they admitted ability to recognize only 40 per cent of cavities by physical examination alone. Close scrutiny of the films in a series of cases recently reported from Saranac Lake showed that only 5 per cent of the cavities were recognized on physical examination. This, of course, means the inclusion of every annular shadow, however small, which is interpreted as indicating a cavity of more than microscopic dimensions.

The recognition of cavitation is admittedly not necessary to establish the diagnosis of active tuberculosis, but may be of considerable value in the *differential diagnosis*. There are many nontuberculous conditions which may simulate tuberculosis, both symptomatically and by physical signs. The differentiation of pneumoconiosis from tuberculosis is not always easy; especially is this true when the two coexist, as is frequently the case in third-stage silicosis. Tumors of all kinds may give rise to physical signs identical with those of tuberculosis. The symptoms of early bronchiectasis, syphilis of the lungs, early malignancy, coccidioidal granuloma, etc., are at times indistinguishable from those of tuberculosis, and the physical findings may so closely approximate them that it is difficult, if not impossible, to get along without the aid of roentgenograms.

From the standpoint of *prognosis,* not only is it desirable to know whether we are dealing with a predominantly proliferative or predominantly exudative type of lesion, but it is important to know whether cavitation is present, and if so, its location, extent, and the character of the reaction in the tissues surrounding it. The more extensive the cavitation the graver is the prognosis. Cavities in the apex are less serious than cavities lower down in the lung. A cavity which is surrounded by a very thin wall, with little evidence of fibrosis, indicates a more recent process than one which is surrounded by a dense fibroid wall. The details of the pathology in the deeper portions of the lung which are not accessible to physical examination are also an essential part of the picture.

Of even greater importance than the prognosis, however, is *treatment*. The time is long past when the physician who simply puts his tuberculous patient to bed and on a high caloric diet can be considered as having done his duty by that patient. The development and perfection of the various methods of collapse therapy have entirely changed the outlook for a large proportion of patients. Without the aid of the x-ray it is impossible to fully evaluate the pathologic changes in the lung and reach a proper decision as to whether the case is one requiring the institution of collapse therapy, and, if so, the proper type.

The patient's symptoms and the physical findings tell us much about that patient's *progress,* but occasionally they may be misleading. The lesion may be progressing in the face of symptoms which are stationary or even improving. It may be healing and yet the physical signs be increasing. Visualization by means of the x-ray is frequently the only means of telling the true state of affairs, and serial x-rays, taken at intervals, furnish an unquestionable index of the patient's progress. Early extensions in the better lung are frequently deep-seated, and may give evidence of their presence on the film weeks, or even months, before physical signs appear.

The diagnosis of *activity* on the basis of a single or stereoscopic roentgenogram is seldom justified, and has many times wrought much injustice and even serious injury to the patient, to say nothing of embarrassment or worse to the doctor. If serial pictures show a progressive lesion, it is conclusive evidence of activity either at the time of the previous picture or subsequent thereto.

If collapse therapy is undertaken, the x-ray is indispensable. Only by its aid can we determine the degree of collapse of the lung, the presence of adhesions which may be preventing complete collapse, the status of the cavities, and the position and integrity of the mediastinum, etc.

In the detection of *childhood tuberculosis,* we have to depend upon the x-ray to a much greater degree than in the adult types. These lesions, which follow *primary infections,* are prone to develop without sypmptoms, and as a rule are of such small extent that they are not detectable by physical signs alone. The use of the x-ray in making surveys of large groups of young children, particularly contacts with open cases, has shown the existence of an astonishing number of active infections of this type, and has made necessary a complete revision of many of our concepts regarding the character of tuberculous infection in childhood, and the resistance of the child and adult to first infection.

These lesions are essentially benign, and the vast majority of them subside without material damage to the lung, leaving only a few fibrous strands or a small fibrous nodule which shows a marked tendency to calcification, and/or one or more calcified hilum nodes. Of these areas, it may safely be said that they are impossible of recognition during life except by means of the x-ray.

To sum up: The x-ray should always be used in conjunction with a physical examination of the chest. Its value in assisting the clinician to reach a conclusion as to the presence of active tuberculosis will be in inverse proportion to his skill in eliciting and evaluating the history and physical signs, with such aid as the bacteriological laboratory can give him. Beyond this, however, and second in importance only to such diagnosis, the x-ray is an invaluable aid in establishing the detailed diagnosis usually necessary for prognosis, and is *always* necessary for intelligent treatment.